

118 Pigs and the Big Bad Wolf

An Investigation into the Chemical Elements



Experimental Aims

Greetings, my name is Professor Wolfram, head of the Anti-Wolf Predation Department at Swine University. I recently got the job to investigate wolf-proof structures for improved pig protection (chuckle). This work is based on earlier studies looking at straw, stick and brick-houses for which it was concluded that brick was the best building material.

However, we have recently been made aware that more than 3 materials exist! In fact, there are 118 chemicals elements known which could potentially be even better than brick. These can be listed in the periodic table (over there -->).

To test the merits of each element as a building material, 118 of the most disposable and tasty Swine University students were set the task of building houses from each of the chemical elements. If the student survived the construction process the structure was tested against wolf assault, carried out by myself. Also, any interesting observations during the process were noted. I have created a ranking system to sort the elemental houses (over there -->).

Using it I gave the straw house 2 stars, stick house 3 Stars and the brick house 5 stars.



H	Each element has its own one or two letter symbol. The actual names of the elements are later in the book.															He		
Li	Be											B	C	N	O	F	Ne	
Na	Mg											Al	Si	P	S	Cl	Ar	
K	Ca	Sc		Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y		Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	*	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac	**	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	Fl	Mc	Lv	Ts	Og
			*	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	
			**	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr	

Star Rating Criteria

0 - Could not make a house out of this element (gas, liquid or non-existent in nature)

1 - Infeasible in reality to make a house from this element (very reactive or very toxic or other major issue)

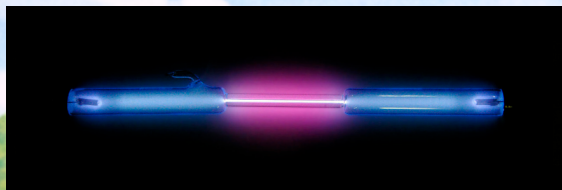
2 - House could be made but would not be practical to be in (reactive or toxic) or wolf could easily break in

3 - House could be made but would not protect from sustained wolf attacks (weak strength, slightly reactive or toxic)

4 - Robust, nontoxic, non-radioactive, does not rapidly degrade but expensive (Pig survives)

5 - Robust, nontoxic, non-radioactive, does not rapidly degrade and cheap! (Pig survives)

1. Starting with a Bang: Hydrogen (H)



You can't see hydrogen but with a high electrical current in a vacuum it glows purple!



Hydrogen (H) is a colourless, odourless gas much lighter than air, so useless as a building material as it just blows away. However, what it does do well is explode. This cooked the test subject making them even more enjoyable when eaten. Needless to say, experiment not successful, but in another way self-cooking pigs is a good start.

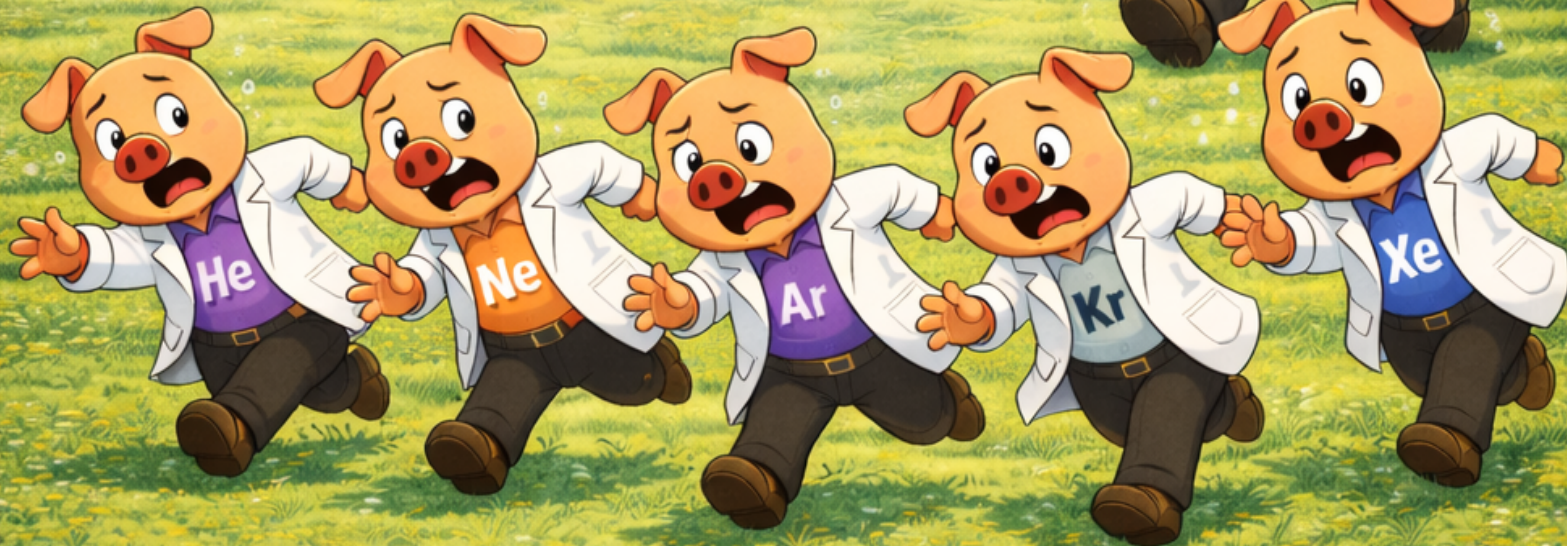
House Rating: 0 Stars

2. The Noble Gases (He, Ne, Ar, Kr & Xe)

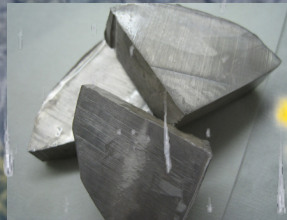
Helium (He), Neon (Ne), Argon (Ar), Krypton (Kr) and Xenon (Xe) are known as the noble gases because they don't react with anything. All are colourless and odourless and as they are not air caused the test subjects to get all woozy. This made it very easy to catch them, another failed test.

Interestingly when the pigs breathed in the gases it changed how they sounded. The helium pig's voice became very high pitched and the Xenon pig voice became very deep (in summary: sounded funny tasted great).

House Rating: 0 Stars for all



Like hydrogen, these gases are invisible but can be made to glow in a range of colours



3. Metals That Burn in the Rain (Li, Na, K, Rb, Cs, Sr & Ba)

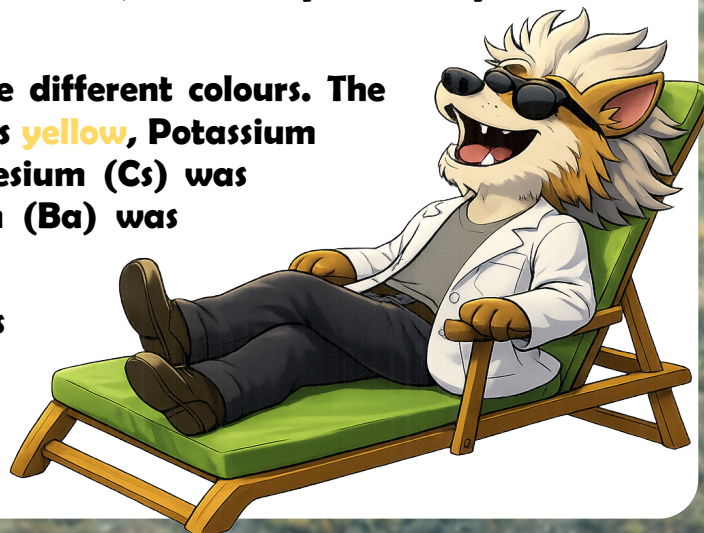


On the far left hand side of the periodic table are some metals so soft they can be cut with a knife. However, they are solid so that is a step in the right direction. When the pigs started to build, their houses were shiny silver or gold in colour. However, they rapidly reacted with the air and became dull. Unfortunately, shortly into the experiment it started to rain and the houses started to catch fire and explode. All these metals quickly reacted with water to make hydrogen which, as already shown by the hydrogen pig, likes to go bang.

Interestingly, all the fires and explosions were different colours. The Lithium (Li) fire was **crimson**, Sodium (Na) was **yellow**, Potassium (K) was **lilac**, Rubidium (Rb) was **violet**, Caesium (Cs) was **blue**, Strontium (Sr) was **scarlet** and Barium (Ba) was **green**.

Sadly, none of the test pigs could be eaten as there were no remains and the ash from the fires was horribly corrosive.

House Rating: All 1 Star



4. Metalloids Part 1: The OK ones (B, Si, Ge & Sb)

As you might guess the metalloids are a group of elements that are a bit like metals but not quite. Boron (B) is a shiny silver-black element whereas Silicon (Si) is shiny blue-grey element. Neither react with air or water, they make reasonable building materials and are nontoxic. The Germanium (Ge) and Antimony (Sb) houses were both lustrous and silvery. They too showed no reactivity with water or air, were nontoxic and easy to build with. However, both were too soft to prevent the wolf breaking in for long.



So that's the first set of metalloids, not toxic, not catching fire, and OK wolf protection. At least the elements not actively killing the pigs was a step forward at this point. Maybe the next set of metalloids would be better... (see Metalloids Part 2: The ones that make you smell of garlic then die)

House Rating: Silicon & Boron 4 Star, Germanium and Antimony 3 Star



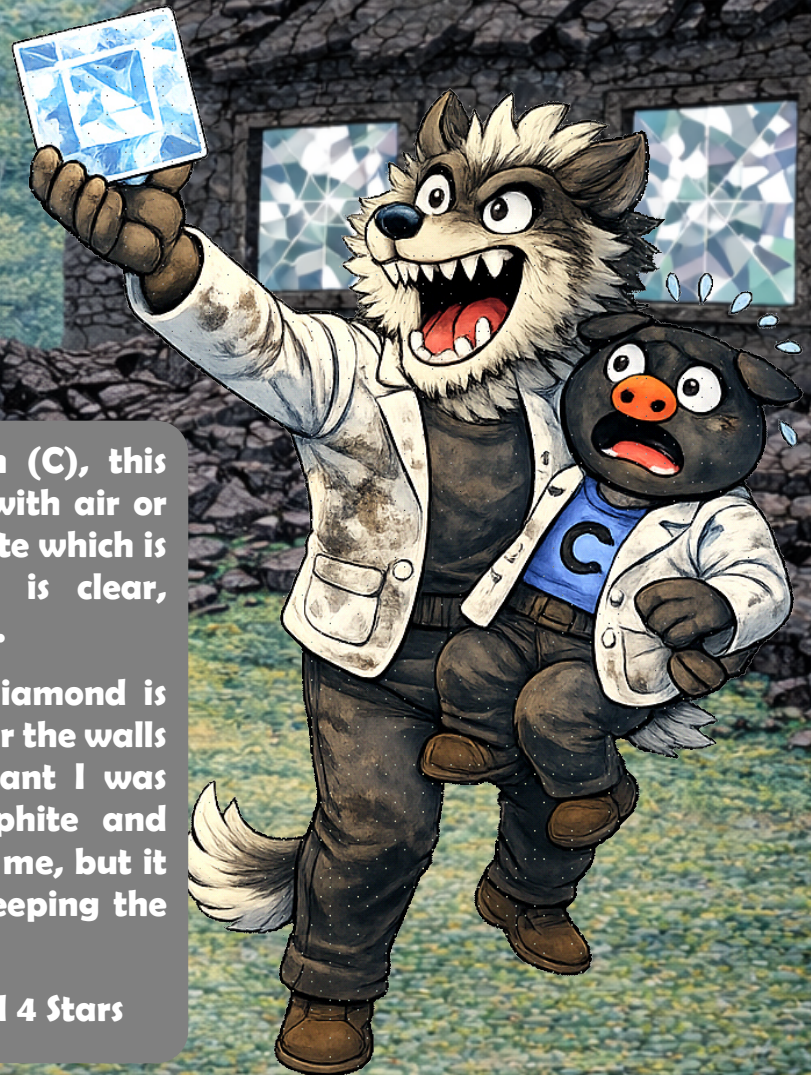
5. Two Forms: Carbon (C)



One pig made his house out of Carbon (C), this element is non-toxic and does not react with air or water. Carbon comes in two forms; graphite which is black and weak and diamond which is clear, colourless and the hardest element known.

However, graphite is very cheap, and diamond is very expensive, so the pig used graphite for the walls and diamond for the windows. This meant I was easily able to break through the graphite and gobble up the pig (black powder all over me, but it worth it to get some lunch! Also, I am keeping the windows).

House Rating: Graphite 3 Stars & Diamond 4 Stars



6. Air (N & O)



Two dim piggies tried using Oxygen (O) and Nitrogen (N) to build their house. Air is 78% Nitrogen and 21% Oxygen (the rest is mostly Argon, see noble gases). So essentially, they tried to build houses out of air. They were eaten immediately. At least this meant a quick write up for me after dinner.

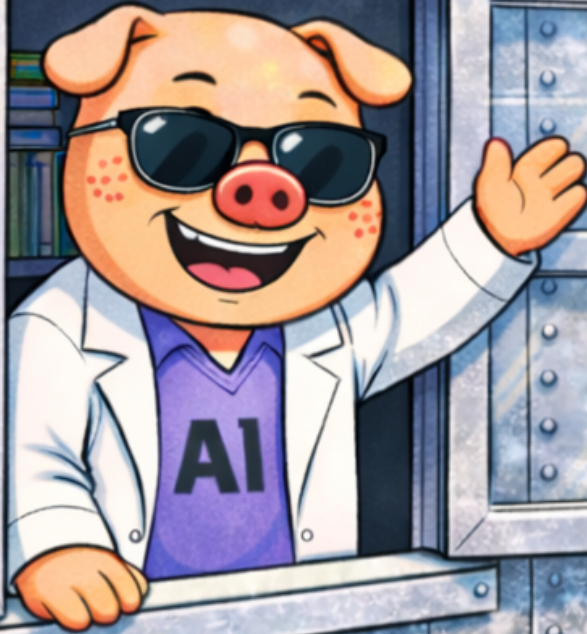
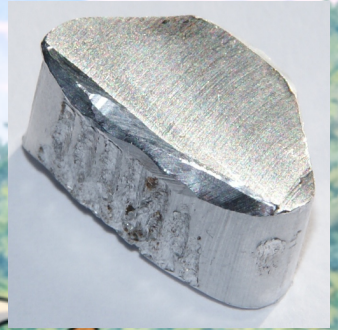


Nitrogen and Oxygen are invisible gases but make them very cold and they turn to liquids. Nitrogen is colourless and oxygen is blue (and magnetic!)



House Rating: Both 0 Stars

7. Passivating Aluminium (Al)



Finally, now we are getting somewhere. The Aluminium (Al) pig's dull silver house easily held off wolf attacks and didn't even corrode in the rain. Good choice that pig!

Interestingly Aluminium is actually very reactive and its surface quickly bonds with oxygen in the air. However instead of corroding away the surface layer forms a protective barrier making the Aluminium very stable. This process is called passivation.

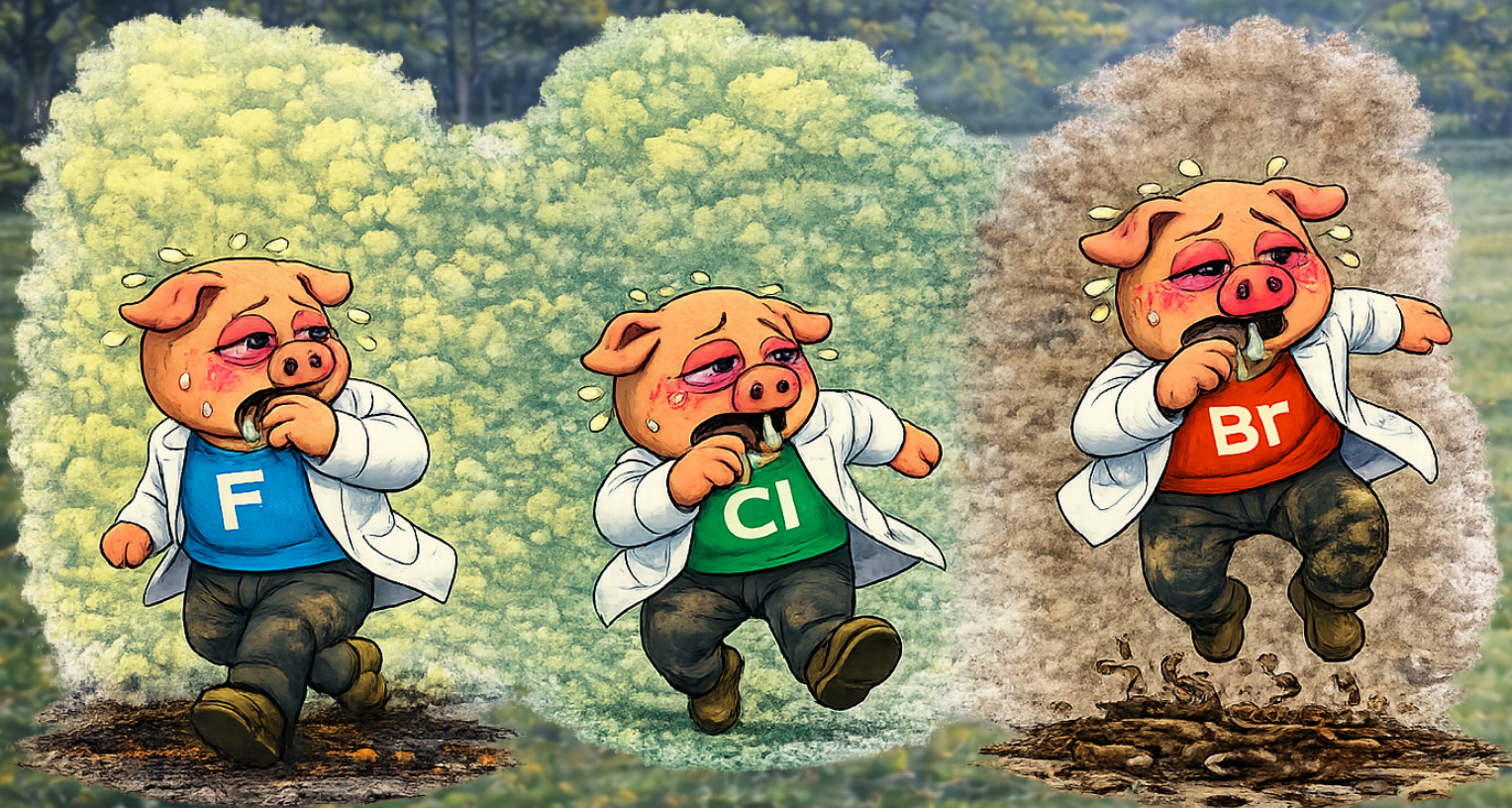
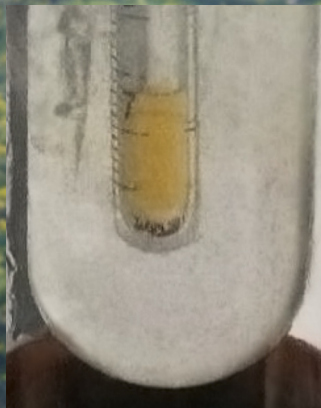
Aluminium is also very abundant along with being strong and cheap; a very good building material! (How annoying.)

House Rating: 5 Stars



8. The Horrible Halogens (F, Cl, Br & I)

The some of the unluckiest pigs of all tried to use the halogens to build their houses (these are found on the far right hand side of the periodic table). I mean seriously run away from halogens (except perhaps iodine). The rest are super **toxic**, smell terrible and burned the pigs horribly.



The Fluorine (F) pig died horribly in a yellow cloud (which also caused everything around it to catch fire).

The Chlorine (Cl) pig died horribly in a green cloud.

The Bromine (Br) pig died horribly in a brown puddle.

The Iodine (I) pig was the only one able to build a house as it is the only solid halogen. It is a lustrous purple solid, unfortunately it isn't very strong and also toxic. The pig fled the house to escape the poisoning but was then eaten (I regret this, it tasted weird, I'm not even going near the others).

House Rating: Iodine 2 Stars the rest 0 Stars



9. Pyrophoric Phosphorous (P)



4 different kinds of Phosphorous

Phosphorous (P) comes in a range of colours, red, white, black, purple and sometimes even glows in the dark.

However, it is **pyrophoric**. This means it will catch fire all by itself for no reason and can't be easily put out. This is obviously a terrible drawback when trying to build a house. Also, did I mention both it and the smoke it gives off when it burns are highly **toxic**.



The phosphorous pig was burned to a crisp, I fled.
House Rating: 1 Star



10. Crumbly Sulphur (S)

The Sulphur (S) house was bright dandelion yellow and did not burn, was non-toxic and, despite what you might have heard, didn't even smell bad (that's sulphur compounds). So far so good, however sulphur is very crumbly (like a boiled egg yolk) and it was easily possible to smash in.



Fun fact molten sulphur is blood red, like this pig

House Rating: 2 Stars



11. Light Metals: (Be, Mg, Ca & Sc)

These pigs had an easy time building as these are among the lightest metals known. The Beryllium (Be) pig found their element to be a hard silvery metal if a bit brittle. He was worried that a wolf would be able to break in but what he should have been worried about was how very **toxic** Beryllium is. He found he developed a horrible cough, lost weight and then died. This made him a very bony meal.



The Magnesium (Mg) and Calcium (Ca) pigs built houses which were shiny grey and pale yellow, respectively. These elements might look nice but as the pigs built, they turned out to be quite flammable, they also fizzed in the rain as they both react with water. This led to their houses rapidly collapsing and the inevitable wolf predation.

The pig who built the Scandium (Sc) house survived the longest of these four building a silver house which tarnished to a lovely pinky-yellow over time. However, Scandium is too soft to protect a pig forever and eventually he too was gobbled up.

All 2 stars except Scandium 3 stars

12. The Magnetic Elements (Fe, Ni, Co & Gd)



House Rating:
Iron 5 Stars,
Nickel and
Cobalt 4 Stars,
Gadolinium 2
Stars



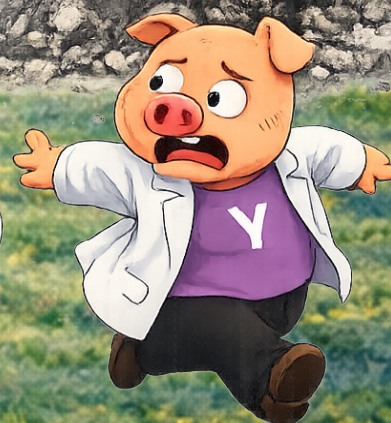
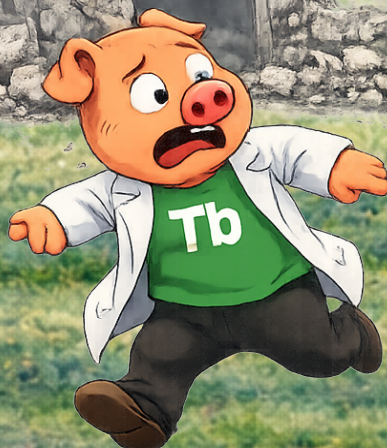
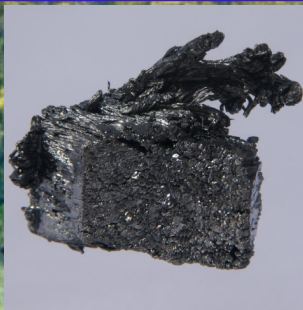
Being magnetic is only one of the things the pigs found attractive about these elements. The Iron (Fe), Nickel (Ni) and Cobalt (Co) houses were all excellent keeping the wolf at bay and only corroding very very slowly in the rain. Iron was also cheap enough to be 5 star.

Unfortunately for the Gadolinium (Gd) pig, the rain caused his house to turn white and fall apart in only a few short weeks and we all know that a hungry wolf is more than capable of being patient for that long. Oh, and Gadolinium also turned out to be mildly **toxic** as well.

13. Six from Sweden (Y, Tb, Ho, Er, Tm & Yb)

Six of the pigs travel to the town of Ytterby in Sweden where many elements have been discovered. From these elements found at Ytterby they made six silvery houses. All six stood just about long enough for the pigs to get inside.

The Terbium (Tb) and Thulium (Tm) houses corroded over the course of a couple of weeks exposed to the wind and rain. However, the student pigs were not around to observe this because these metals are very soft, you could easily cut them with a knife. Turns out this means they couldn't keep a wolf out for long.



The other 4 elements (Yttrium (Y), Holmium (Ho), Erbium (Er) & Ytterbium (Yb)) were only marginally better, again they did tarnish slowly (after a while the Erbium went a nice shade of pink!) but as they were harder they lasted longer as protective structures. Not much longer, however, as they are still quite soft. The pigs tried to see this as a bright side before they were eaten. Plenty of Swedish meatballs to go around with elements like these! On second thoughts long term exposure shows all these elements are slightly **toxic** so maybe I'll only have a few.



Terbium & Thulium 2 Stars, Yttrium, Holmium, Erbium & Ytterbium 3 Stars

14. Brittle to Ductile (Mn, Zn & Cu)

Brittle materials break easily as they can't bend very far, the opposite of this are ductile materials that can bend without breaking. As you can imagine, brittle materials are not best suited for wolf shelters.

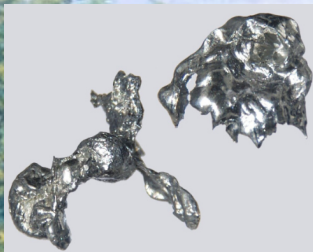


Manganese (Mn) is a silvery-grey metal that is hard but very brittle and also slowly corrodes, going black-brown. Finally, it is also **toxic**, messing up brains. Zinc (a lustrous blue white metal), is better as it only slowly tarnishes in air but is robust enough to fully protect from wolves. Copper (Cu) is a unique orange-red metal which is ductile and can be easily formed into all sorts of useful

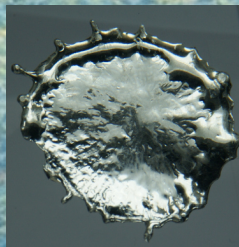
shapes. It does slowly tarnish in air, 30 years into the experiment the copper house would go green. However, as it is non-toxic, cheap and can prevent wolf attacks, the copper pig felt pretty smug.

House Rating: Manganese 3 Stars, Zinc 4 Stars & Copper 5 Stars

15. Softness and Sound: (Cd, In & Sn)



The three pigs given Cadmium (Cd), Indium (In) & Tin (Sn) were hopeful, all three elements are soft silvery metals which didn't immediately suffer terrible failures in the rain. However, problems were soon to reveal themselves.



House	Rating:
Cadmium	2 stars
Indium and Tin	3 Stars



After living in the Cadmium house the pig soon found out his house was **toxic**. His bones fell apart and his kidneys failed, then he died much to his relief. The Indium pig fared only slightly better as Indium is the softest element. Indium is so soft you can chew it like gum, but probably shouldn't as long term Indium

exposure causes lung failure. The Tin pig was pleased to find Tin is not toxic. Interestingly as he bent some tin pieces into shape the metal would screech. However, after a very cold night the tin house changed form from a silvery metal into a crumbly grey powder. Powders don't stop wolves, make a note. Turns out both the tin house and tin pig make a loud screech.

16. Metalloids Part 2: The ones that make you smell of garlic then die (Se, Te & As)

House Rating: Arsenic 1 Star, Selenium & Tellurium 3 Stars

The second set of metalloid pigs made their houses from Selenium (Se), Tellurium (Te) and Arsenic (As). The Selenium house was black and glassy and gave off a red dust, the Tellurium house was silvery and the Arsenic was shades of grey. Then the Arsenic pig just dropped dead because Arsenic is super **toxic**, leaving behind a corpse smelling of garlic.



The Selenium and Tellurium pigs were worried because their houses were very brittle. However everyone kept away from them. This is because Selenium and Tellurium are also **toxic** and cause you to develop monumentally bad garlic breath. Sadly, the next symptoms of Selenium and Tellurium poisoning are hair loss and death, so all in all these houses were not judged successful.



17. The First Radioactive elements (Tc & Pm)

Technetium (Tc) and Promethium (Pm) are the first **radioactive** elements. **Radioactive** elements are not stable and transform into different elements, emitting radiation. This radiation is harmful and, in high amounts, causes death from cancer or organ failure.

This radiation also causes the material to heat up. If you had enough of a radioactive element to build a house it would heat itself, or melt itself, or vaporise itself, or just catch fire and explode.



Pure Technetium however is only mildly **radioactive** compared to some elements. However It rapidly tarnished in the air going yellow. I wisely ignored the Technetium house but the pig painfully succumbed to the radiation in a few days, so this was not a win for pig protection.



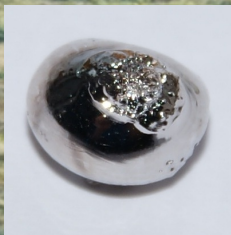
Luckily (or not) for the Promethium pig this element is so rare that there is not enough on the planet to build anything close to a house. So he just got eaten.

Technetium 1 Stars, Promethium 0 Stars



18. Precious Metals!: (Ru, Rh, Pd, Ag, Pt & Au)

These 6 pigs were the envy of all the neighbours. Their houses didn't blow up in the rain, they didn't poison the pigs and the property values were through the roof (although so were the construction costs). However, Palladium (Pd), Silver (Ag) and Gold (Au) are too soft to protect from extended wolf attacks, the pigs were gobbled up and the neighbours were not so envious.



Ruthenium (Ru), Rhodium (Rh) and Platinum (Pt) were just strong enough to protect from wolf attack so just squeak into 4 star ratings.

What was beyond recovery was the university's bank accounts after all the housing materials mysteriously went missing.

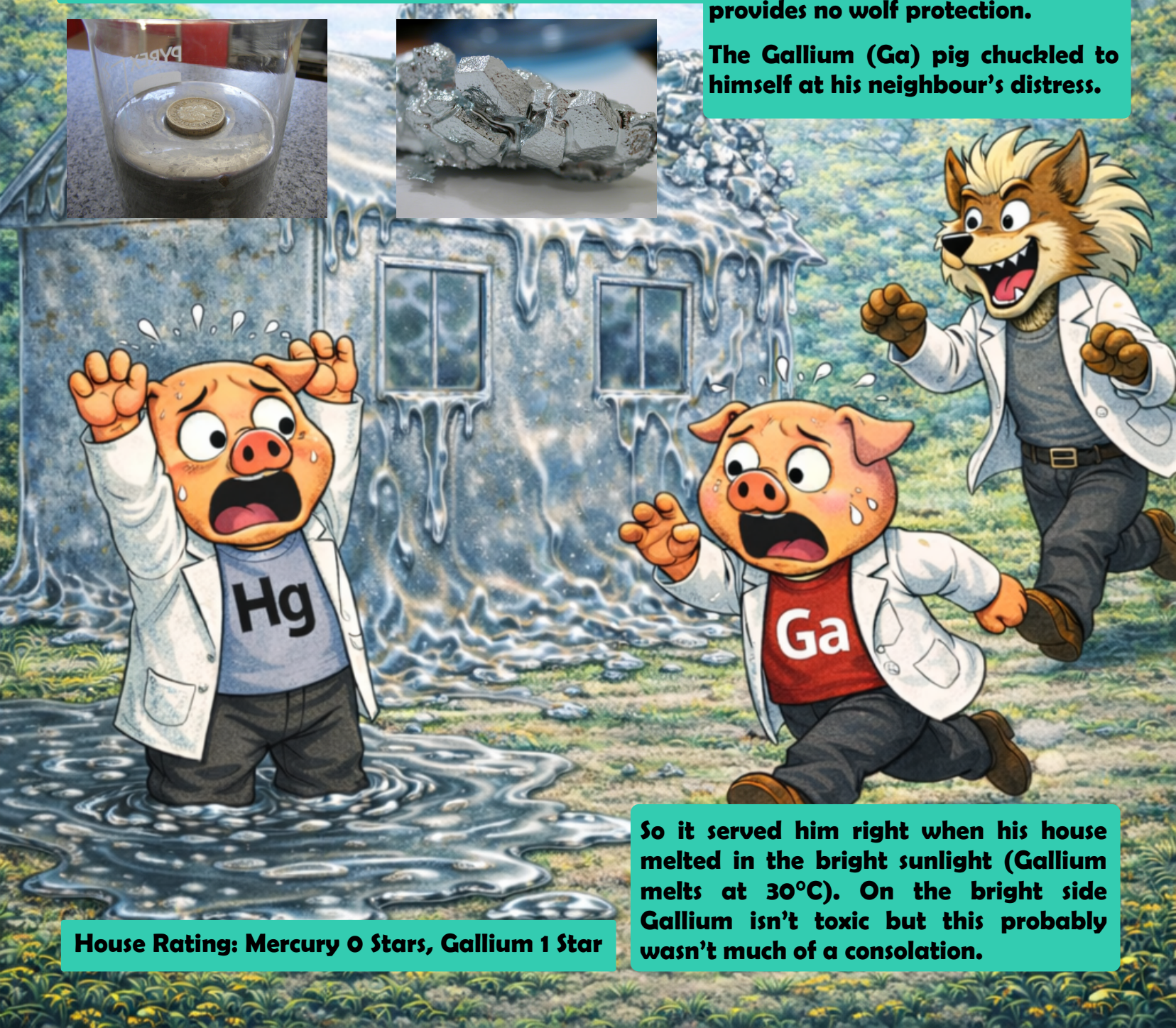
Ru, Rh, Pt 4 Stars. Ag, Pd & Au 3 Stars.



19. The Melty Metals (Hg & Ga)

The Mercury (Hg) pig quickly discovered that mercury is the only liquid metal and after floating around in it for a while it also turned out to be super **toxic**. Also, as a liquid, it provides no wolf protection.

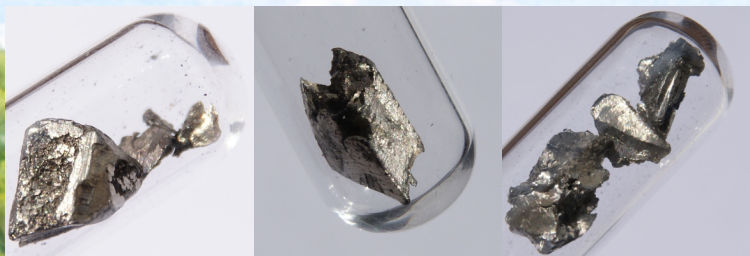
The Gallium (Ga) pig chuckled to himself at his neighbour's distress.



So it served him right when his house melted in the bright sunlight (Gallium melts at 30°C). On the bright side Gallium isn't toxic but this probably wasn't much of a consolation.

House Rating: Mercury 0 Stars, Gallium 1 Star

20. Lots of Lanthanides (La, Ce, Pr, Nd, Sm, Eu, Dy, & Lu)



House Rating: Samarium (Sm), Dysprosium (Dy) & Lutetium (Lu) corrodes more slowly than the others so they get a 3 star rating. The rest get 2 stars.

The Lanthanides are the elements 57-71 (down near the bottom of the periodic table), however we have covered some of these on other pages so these are the rest! In summary none of these elements make very good houses as they react with air, turn a range of pretty colours then fall apart in a matter of days. All are silvery metals.

Lanthanum (La) turns **white** then falls apart. It is also moderately **toxic**.

Cerium (Ce) turns **yellow**, then falls apart but sometimes just catches fire as it is **pyrophoric**.

Praseodymium (Pr) turns **green**, then falls apart.

Neodymium (Nd) turns **grey-blue**, then falls apart. It's also moderately **toxic** and irritating to eyes.

Samarium (Sm) turns **grey-yellow**, then falls apart.

Europium (Eu) turns **white**, then falls apart (faster than any other Lanthanide).

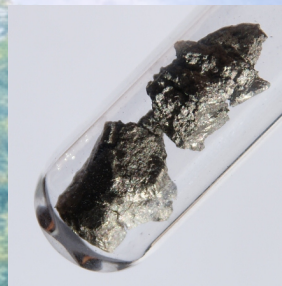
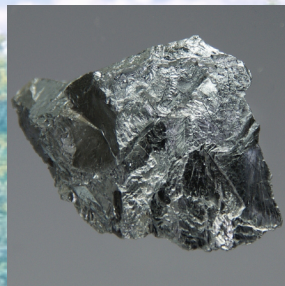
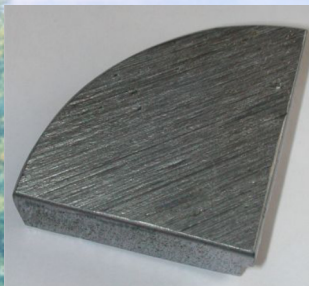
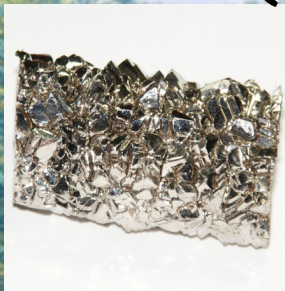
Dysprosium (Dy) turns **green-yellow**, then falls apart.

Lutetium (Lu) turns **white**, then falls apart, but only when it rains a little bit.

Needless to say, none provide wolf-proof protection.

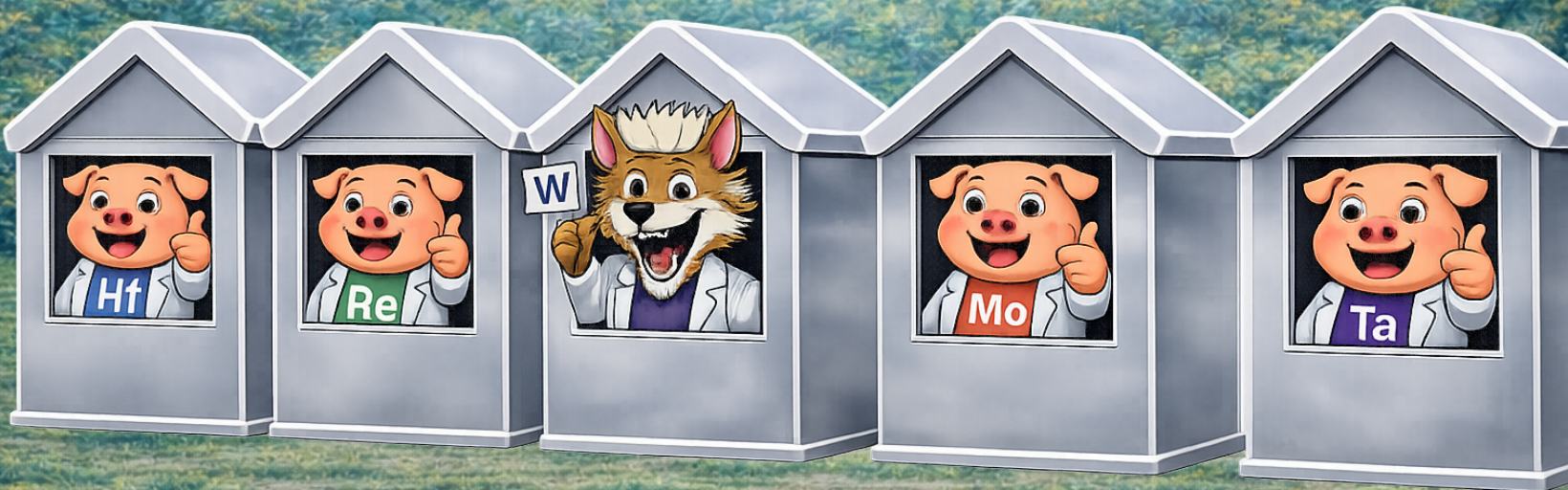
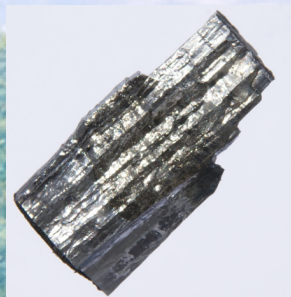
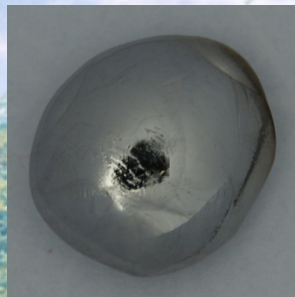
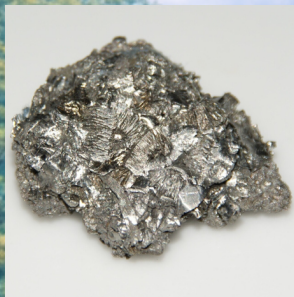


21. Engineering Metals (Ti, V, Cr, Zr, Nb, Ta, Hf, Mo, W & Re)



Now we're talking! These are some excellent building materials, if very boring in appearance. They are all silvery metals which do not corrode in air or water (they passivate) and have minimal toxicity. They are also strong and wolf-proof.

The only drawback is the cost; many are quite pricey. The cheapest are Chromium (Cr) and Titanium (Ti) which gives them a 5 star rating! The others are all still fantastic building materials (Vanadium (V), Zirconium (Zr), Niobium (Nb), Tantalum (Ta), Hafnium (Hf), Molybdenum (Mo), Tungsten (W) & Rhenium (Re)).

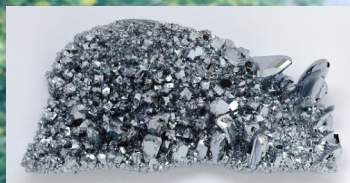


On a side note the Tungsten house is so awesome, I tricked the student out, ate them and stayed in the house (this was the students fault not the Tungsten's so its 4 star rating remains). Tungsten's symbol (W) comes from the German name for the element, Wolfram, which is my name! I love my Tungsten house! It also has the highest melting point of any element, an amazing 3,422°C! 10 stars. Best house ever!

All 4 stars except Titanium (Ti) and Chromium (Cr) both 5 Star



22. Heavy Metals: (Os & Ir)



The Osmium (Os) and Iridium (Ir) pigs had a very difficult time building their houses as they are the densest (and among the rarest) of all elements. A one litre bottle of these elements weighs 22.5 kg! However, when completed both made robust shiny silvery houses, with the Osmium house having a blue tinge.



House Rating: Iridium 4 Stars, Osmium 2 Stars

Iridium is the most corrosion resistant of all the elements and proved wolf proof. So all in all, a good choice.

The Osmium house also seemed good, however after a while it started to stink like bleach as it reacted with the air to produce an incredibly **toxic** gas. This gas stained the pig's eyes black, blinding him, then he died. So, not a good choice after all.

23. The Last Stable Elements (Tl, Pb & Bi)

The shiny Thallium (Tl) house rapidly tarnished to a blue-grey tinge, giving off dust. However, before the house could fully collapse, the thallium pig had succumbed to its incredible **toxicity**. The Lead (Pb) house was a dull silver grey. Unfortunately for its resident pig, it is too soft a metal to prevent wolf attacks. However, Lead is also a **toxin** that slowly builds up in the body destroying the brain. So, in a way being eaten was the least painful of the options.



The Bismuth (Bi) house was originally a shiny silvery-pink, however when it was exposed to the air its surface became covered with iridescent hues all the colours of the rainbow. All the pigs agreed it was the most colourful of all the houses. However it was brittle and easy to break into.



Thallium 1
Stars,
Bismuth &
Lead 3 Star

24. Getting Radioactive (Po, At, Rn, Fr, Ra, Ac, Th, U)

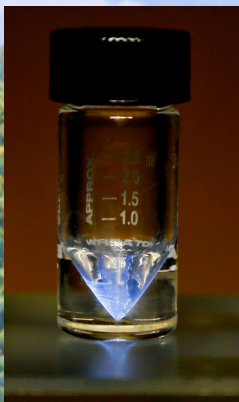
After a very brief study, the pigs soon discovered these elements have significant drawbacks as building materials. The Francium (Fr) and Astatine (At) pigs found their elements are so **radioactive** that they would evaporate themselves. However, this means there isn't enough of these elements on earth to build a house, so these two pigs just got eaten.

Polonium (Po) and Radium (Ra) were discovered by a Marie Curie. Marie Curie died of radiation poisoning. The pig who tried to build their house out Polonium suffered the same fate. The Radium pig would have as well, but do you remember the metals that burn in the rain from earlier on? Radium is also a metal that burns in the rain (with a nice red flame), but of course, has the added bonus of being **radioactive**.



Uranium (U) and Thorium (Th) were not highly **radioactive** (pew). Unfortunately, they are noticeably **pyrophoric**. At first the pigs noticed these two metals tarnishing rapidly in the air, then they caught fire. Obviously not suitable for wolf protection.



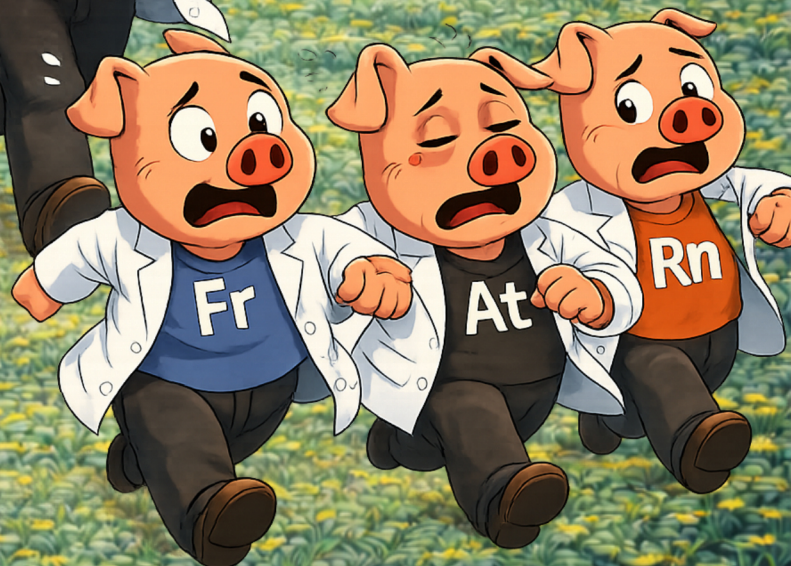


House Rating: Francium,
Astatine, Radon, Actinium
0 Stars; Polonium,
Radium, Uranium and
Thorium 1 Star



Do you remember the noble gases and how they blew away and left the pigs to be eaten? Radon (Rn) is a noble gas just also **radioactive**. So the Radon house also blew away, irradiating the pig slightly before he was eaten.

Actinium (Ac) is so massively **radioactive** it glows blue as it rips the air apart. It also reacts rapidly with air and water, turning white. Needless to say, not house building material as acute radiation poisoning is no joke.



25. Fissioning elements: Blue flashes followed by catastrophe (Np, Pu & Am)



Neptunium (Np), Plutonium (Pu) and Americium (Am) are all dense silvery metals. It turned out that all three are **pyrophoric** and highly **toxic**. They also all feel warm due to ongoing **radioactive** decay.

Despite this, the three pigs carried on stacking more and more blocks of the metals together struggling valiantly to build a house. Suddenly all three houses emitted a blinding blue flash of intense radiation and caught fire. The pigs were swept up in a raging **radioactive** inferno and (luckily for them) died rapidly.

This was all caused by the elements undergoing uncontrolled nuclear fission (falling apart into smaller elements) releasing a vast amount of radiation in the process, ripping air molecules apart which caused the blue flash. The radioactive fumes and debris from the houses contaminated the entire region and prevented all habitation in the area for hundreds of years. Considerable damage was also done to the university's reputation. For legal purposes, I would like to clarify that I was in no way involved.

House Rating: All 0 Stars (would go negative if I could)

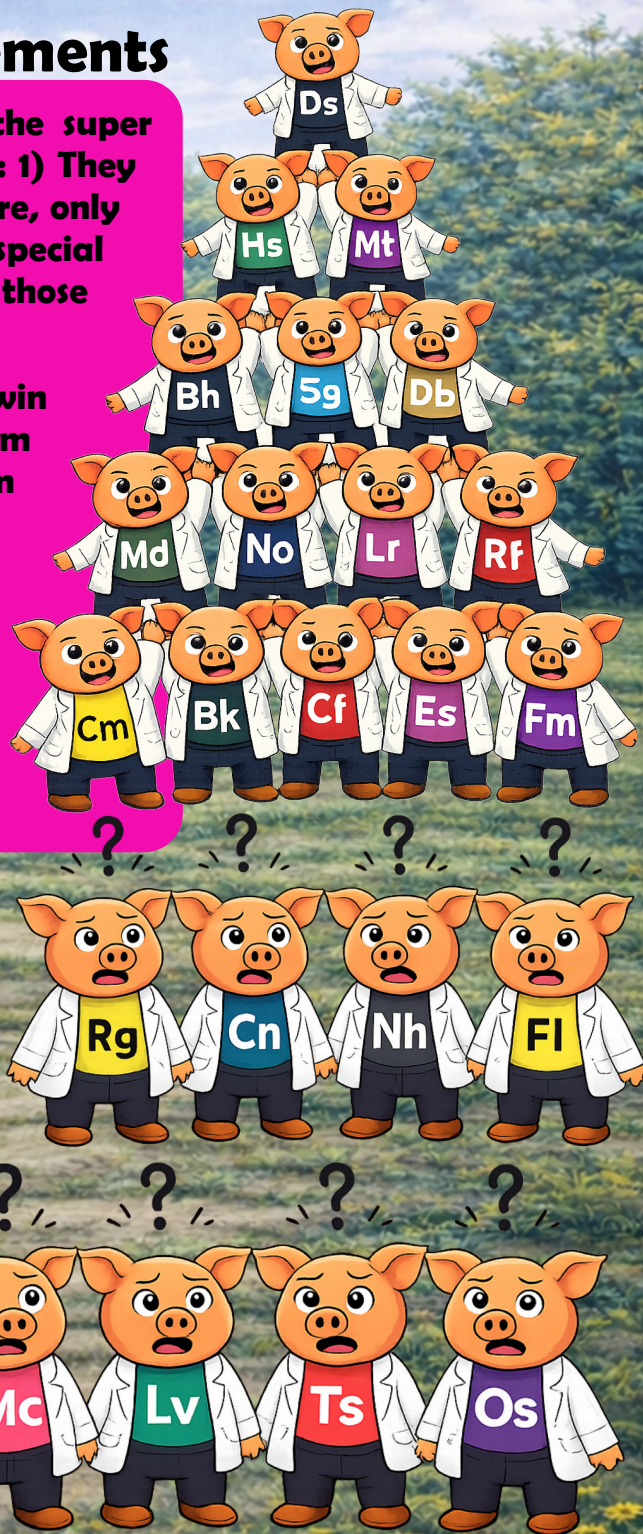
26. Super Massive Synthetic Elements

The final pigs tried to build their houses out of the super massive elements. However, they had two problems: 1) They are all really **radioactive**; 2) They don't exist in nature, only in miniscule amounts for fractions of a second in special laboratories. As problems with building materials go, those are quite sizable.

If you really want a list these elements to help you win quizzes here they are; Protactinium (Pa), Curium (Cm), Berkelium (Bk), Californium (Cf), Einsteinium (Es), Fermium (Fm), Mendelevium (Md), Nobelium (No), Lawrencium (Lr), Rutherfordium (Rf), Dubnium (Db), Seaborgium (Sg), Bohrium (Bh), Hassium (Hs), Meitnerium (Mt), Darmstadtium (Ds), Roentgenium (Rg), Copernicium (Cn), Nihonium (Nh), Flerovium (Fl), Moscovium (Mc), Livermorium (Lv), Tennessine (Ts) and Oganesson (Os).

However, the pigs didn't worry where or why these elements came from as they had all been mysteriously eaten. On an unrelated note, I need a little lie down.

House Rating:
All 0 Stars



Conclusions and Future Work?



In summary the 5 star elements to build from are Aluminium, Chromium, Iron, Copper and Titanium. We recommend these materials for future house building projects. I personally disagree, Tungsten clearly was the best.

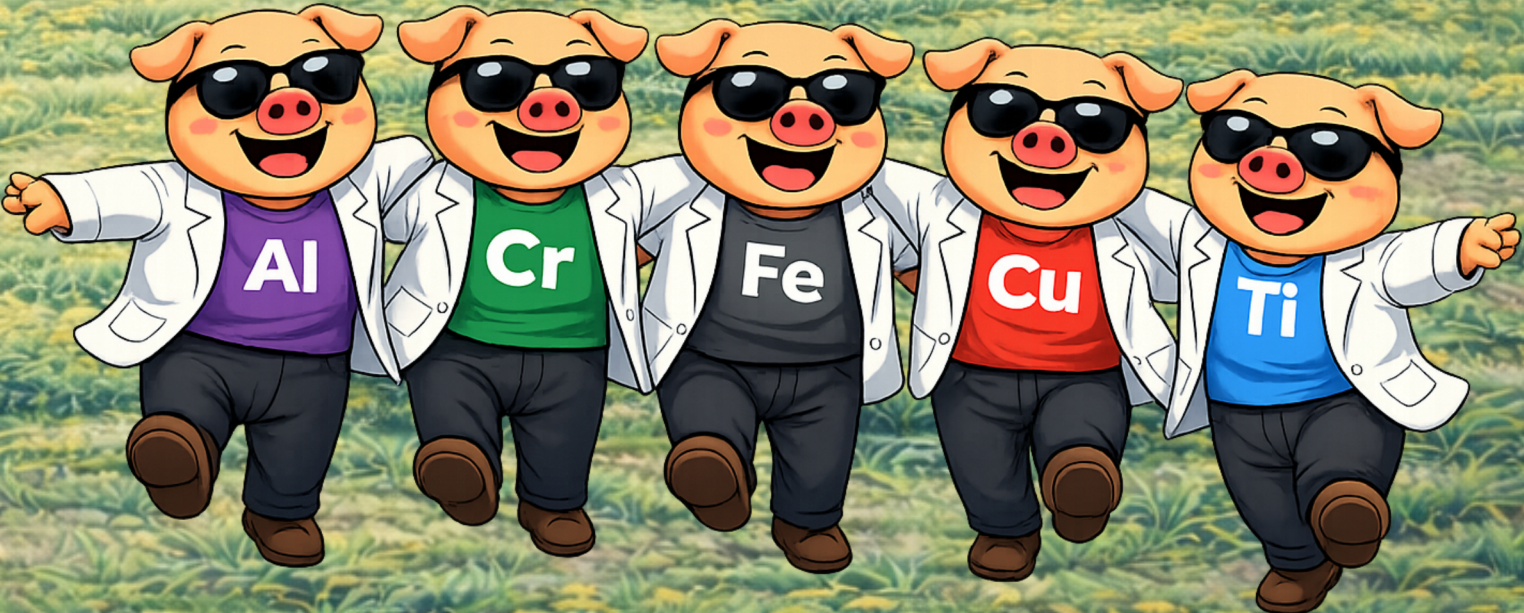
The rest were at best too expensive and at worst **pyrophoric**, **toxic** and **radioactive**. Of 118 elements tested only 21 protected the pigs from wolf attacks, (it would have been 22 if the carbon pig had made the whole house from diamond).

However, it was found that even the 5 star houses were not very comfortable, can you imagine living in an all metal house? This raises a question if everything is made from elements then what are straw, sticks and brick made from? As it turns out, it is possible to combine elements together to make new substances with even better (or worse) properties than the elements alone. For example, sticks are mostly made from carbon, hydrogen, oxygen and nitrogen. Three of those scored 0 stars and are gases! However together they make wood, one of the most versatile building materials.

If you take issue with any of the findings and number of stars assigned to elements in this study, please feel free to discuss with your nearest chemist, not us, as we still have legal issues from the fissionable elements disaster and the loss of so many students. Also, the cost of the precious metal houses. However, if you would like to fund our research or know a cheap source of more students, please feel free to get in touch.

House Star Rating

H																	He		
Li	Be													B	C	N	O	F	Ne
Na	Mg													Al	Si	P	S	Cl	Ar
K	Ca	Sc		Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr	
Rb	Sr	Y		Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe	
Cs	Ba	La	*	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn	
Fr	Ra	Ac	**	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	Fl	Mc	Lv	Ts	Og	
				*	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	
				**	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr	



Some of the Simplifications and Outright Lies

This book is full of stretches of reality, but what do you expect from a book about pigs who build houses? Its purpose was to introduce people to the variety of behaviours of the elements in a hopefully interesting way. Below are some, but not all, of the slight embellishments added to highlight interesting facts. If you read them, you can feel smug when you talk to people who haven't. Firstly, it should be pointed out that all lab coats should be done up, and safety glasses should have been worn by the Professor Wolfram and the student pigs.

When performing the thought experiment on each house, it was assumed the pig had brick-sized lumps of the elements to build from, (first assuming the element was a solid and not so radioactive it didn't exist). It was then considered what would happen if the house was exposed to air and rain, and what happens to a pig exposed to the element. The cash cost of the elements wasn't initially considered for the star rating; it was assumed the pigs were able to find enough of that element to have a go at building a house. For example, a precious metal house (like gold) would be infeasibly expensive. Only when elements do not exist in nature (highly radioactive) were the pigs not able to build a house at all. The actual market value of the elements in the real world was only considered when deciding if an element should be 4 or 5 stars. To qualify for a 5-star rating the cost had to be less than \$10 per kg. In reality, prices of elements vary significantly over time. Now on to the lies!

For example, straight away, element 1 hydrogen. It would not just explode on its own, a cloud of hydrogen would just float away and dissipate in the air. There would need to be a source of ignition, like an electrical spark; then, it would explode. Similarly, the noble gases, nitrogen and oxygen would likely simply blow away before they affected the pigs. This is all for the best from a safety perspective, as if they didn't blow away, they would asphyxiate the pigs. Well, the oxygen wouldn't but pure oxygen would just cause the pig to catch fire with a source of ignition. Top tip for life - never breathe anything that is not air.

For the metals that burn in the rain it would likely be far more dramatic than pictured. The blocks of metal would give colourful flames, however it would likely be covered by horrible caustic smoke. For some of the more reactive ones there would also be melting and explosions going on. In reality the metals are rarely pure, and the flame colour is often dominated by the yellow of sodium.

Allotropes are when the same element can exist in different forms, often with very different properties. The most well-known of these is carbon which can exist as diamond and graphite,

however there are at least 8 other types of carbon allotrope alongside these. Also mentioned in this book are the several colourful forms of phosphorus and the forms of tin which can change based on temperature. In fact, the majority of elements have some allotropic forms, however it would have been an even more boring book to cover them all.

In fact, not just 6 but 8 elements can trace their discovery to the town of Ytterby in Sweden. Scandium and Gadolinium were also found there but it was felt they fitted better into other sections (this is why their houses have Swedish flags). Yttrium, Erbium, Terbium, and Ytterbium are all named directly after the town.

The magnetic elements mentioned are examples of a particular type of magnetism called ferromagnetism, meaning they can be made into permanent magnets. Gadolinium is by far the weakest and Erbium and Dysprosium also display some ferromagnetism. Interestingly, there is another form of magnetism called paramagnetism; amazingly, oxygen is paramagnetic meaning liquid oxygen can be pulled around with a magnet.

You may have noticed that most of the elements are silvery metals, which gets a bit repetitive. This is why most houses are shown after they have corroded a bit, that way there could be more colour. This is most true of Bismuth which is a boring silver in appearance unless prepared correctly, which forms the rainbow step crystals.

In reality, there are several different versions of each element called isotopes. If an isotope is unstable that means it is radioactive and every element has some unstable isotopes. For simplicity, if an element had a least one stable isotope it was assumed the pigs built the house out of only stable isotopes. If an element had no stable isotopes (i.e. it was radioactive) then it was assumed that the pigs used only the least unstable isotope to build the house. For radioactive elements like Polonium and Actinium, realistically no house could be made, it would just be too difficult to gather enough element, but the glowing house was too interesting to miss out.

Several more elements are capable of going critical and fissioning. However, these are unstable isotope of elements like Uranium. As in the book it was assumed the pigs used only the most stable isotope, so Uranium was not included in the fissioning elements. If enough of them could be created all the super massive elements can fission. Interestingly the synthetic element Americium finds a use in tiny amounts in fire detectors, so your probably not far from some now, let us know if you see it flash blue!

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